colour works with 14,000 men, and another with 9000, now engaged wholly in the manufacture of high explosives; to the fact that 75 per cent. of the German collieries have coke ovens installed; to the synthetic production of 200,000 tons per annum of ammonia, and the conversion of ammonia into nitric acid.

Great praise was given by Mr. Sharp to the efforts of the older dye-makers in this country and to the new British Dyes (Limited) for their efforts to augment the supply of dyes, and of the Swiss makers he said that he dare not contemplate what our position would have been during the last eighteen months without their aid. Alluding to the desirability of greater sympathy and closer co-operation between dye-users and dye-makers, he quoted the example of a firm with which the Bradford Dyers' Association had been in close association, and with which shortly before the war they had placed a contract for 1000 tons of a colour previously obtained from the only maker in Germany.

The general and fiscal policy urged by the directors of the Bradford Dyers is the appropriation by Government for a term of years of a grant-in-aid of 500,000*l*., to be administered by a commission charged with the duty of securing the establishment of the industry in this country by grants on production and for enterprise and initiative. Such a commission, they think, with enterprising, energetic, and fearless leadership, would secure the establishment of the industry in this country, not only on less debatable lines, but also much more quickly than by import duties. In the absence of import duties, however, it is thought essential to have most stringent provisions to prevent dumping. Whether import duties are imposed or not, the directors feel that special and extraordinary aid is needed, and they believe that such a commission would make the removal of dependence on Germany more certain than could possibly be hoped for by leaving British colour-makers to their own unaided and unco-ordinated efforts.

Mr. Sharp's speech is a weighty utterance, remarkable for the clear perception of the grave national and scientific implications of the dye question; and such pronouncements from our leading industrialists cannot be over-valued for their influence in giving to the public a just perspective.

WOOD PULPS FOR PAPER-MAKING.

IN the revision of values, moral and material, which is imposed upon us under the present awakening to a new order of realities, it is recognised that we have to create in and for the empire a definitive industrial science, and a co-ordinated scientific industry. To contribute to this effectually, science has to concentrate the trained mind upon manufactures, so as to grapple with its problems by scientific method, which is quantitative *qua* matter and energy, and comprehensive *qua* the moral and political factors of production. Manufacturers and business men have the more difficult task of undertaking a whole-hearted study of science so as at least to arrive at a clear grasp of what this comprehensive term connotes in the creative influences of the old order, and the potential directing genius of the new. Both parties to the new order would be thus reciprocally enlightened as a necessary preparation for earnest co-operation.

In either direction of inquiry it is necessary to set out from clear perspectives of related values, and it is self-evident that those of the natural order claim first attention. Thus, in the organic world, cellulose, starch, and sugar represent primary values of preponderating importance. The industries based upon cellulose, starch, and sugar: their production by agriculture, their transformation by mechanical and chemical means into the derived forms in which they are actually used, together with the countless dependent industries of which these derivatives are in turn but the raw materials, constitute an industrial aggregate which represents, say, one-half of the productive energy of the community. An unprejudiced view of the wider relations of these industries would also recognise that Great Britain has well maintained a premier position in their more important sections, as well as in their later and more definitely scientific developments.

This result is due to ordinary scientific, technical, and business enterprise, and the activity of individual pioneers, not to any conscious or co-ordinated movement towards preposed objectives. More particularly is this true of the cellulose industries, which comprise colossal textile manufactures: paper-making, and such special manufactures as nitrocellulose and high explosives, celluloid, and artificial silk; the latter, which is the youngest—in fact a twentieth-century product—rapidly growing from an *article de luxe* to the position of a staple textile.

There is one feature of these industries which marks them for special consideration in relation to the new order to which the civilised world is shaping or being shaped; that is, their almost complete dependence upon exotic raw materials. In the new order of co-ordinated industrial objectives how are we to deal with the present condition of dependence for essential raw materials?

This is much too vast a question to be discussed within the necessary limits of the present article. We must be satisfied to treat a single typical case: and we select the paper-making industry. The modern expansion of this industry in Great Britain has been conditioned by the discovery of new forms of raw material, chiefly of esparto grass (1861), and the wood pulps (1880).

The importation of esparto in the period 1861–1883 steadily increased to 200,000 tons, at which figure it remains constant, with a variation of 5000 tons. The wood pulps, on the other hand, show a uniform progressive increase, and in 1913 the figures reached:—

	Tons
"Chemical" pulps, *i.e.*, wood celluloses	400,000
"Mechanical" pulps, *i.e.*, ground wood	280,000

The technical and commercial points represented in these figures are as follows:—(1) the enormously increased production of paper has been *mainly* conditioned by the utilisation of wood pulps; (2) esparto rapidly displaced rags in the production of printing and writing papers: it established new qualities in papers of this class, producing very fine printing surface with "bulk." (3) The wood pulps (celluloses) were adopted not only on their quality or merits, *as celluloses,* but being obtained from a massive material, they were produced in a state of exceptional cleanliness, and by economical processes.

Moreover, the paper-maker found himself provided with a half-stuff, clean, cheap, and in presumably unlimited quantities. It will be appreciated that a "half-stuff" is half-manufactured stuff, and its introduction displaces the chemical pulping of actual raw material. Hence, a progressive and two-fold dependence of our paper mills upon exotic supplies. This point is very clearly emphasised by the statistics of the census of production.

In the censal year (1907) the gross output of our paper-mills was in value 13,621,000*l.*

In that year we imported:—

	Tons	£
Wood pulps: chemical and mechanical	672,500	3,312,347
Esparto	202,253	738,834

This represented about 80 per cent. of the total of raw materials consumed. We imported of fully manufactured products, *i.e.*, papers and boards, to the value of 5,362,000*l.*, so that our home production was 70 per cent. of our consumption.

The rate of increase of our importation of raw materials will be seen by comparison with the subjoined figures for 1912.

		£
Esparto		743,354
Wood pulp	chemical	3,200,000
	mechanical	1,220,000
Linen and cotton rags		312,351
Miscellaneous		318,700
Total		5,794,405

The wood pulps thus representing 70–80 per cent. of the raw material for this important industry, the question arises, Can we advantageously produce this quantity within the empire? That we have a sufficiency of forest area there can be no doubt. In his estimates of the forest areas of the world, Schlich assigns to Canada 800 millions of acres, whereas Germany, which may be regarded as self-contained in regard to wood-pulp production, has a forest area of only 35,000,000 acres.

It may be interesting to state the average required to supply pulp for producing 300 tons per week of newspaper. This is generally estimated at 2500 acres per annum; a forest area of 100,000 acres would therefore mean a forty years' supply, and as forty years is the period for the spruce to reproduce itself fully in well-matured timber, it is clear that a mill of such dimensions in the centre of this area is a "self-contained proposition."

It is evident that Canada under a system of organised forestry is capable of meeting our full requirements. In further evidence of her productive capabilities it is to be noticed that she is already responsible for about one-sixth of the world's production, as will be seen from the following figures for 1907–1908:—

Annual Production of Wood Pulp for Various Countries, calculated on the Air Dry Basis (1907–1908).

Country	Mechanical pulp Air dry tons	Chemical pulp Air dry tons	Total annual production
Germany	315,000	320,000	635,000
Norway	421,000	270,000	691,000
Sweden	78,000	510,000	588,000
Finland	69,000	52,000	121,000
America	868,000	988,000	1,856,000
Canada	565,000	172,000	737,000
	2,316,000	2,312,000	4,628,000

Under present conditions (1914) there is little exportation of Canadian pulp to Europe, and this small proportion is mechanical pulp.

As to our own islands, the question of afforestation was investigated by a Commission, which published its report in 1909. The Commission concluded that the available area was 9,000,000 acres, which would absorb for development an annual sum of 2,000,000*l.*; in forty years the self-supporting stage is reached. After eighty years the revenue was estimated to reach 17,500,000*l.*, representing 3¾ per cent. on the net cost, calculated at compound interest (3 per cent.).

The question of esparto, if raised from this political point of view, is either that of finding substitutes of indigenous origin, *i.e.*, within the empire, or of cultural experiments towards its establishment in selected areas affording similar conditions as obtain in the Mediterranean littoral.

On the former problem, attention should be directed to the work of the Imperial Institute, and the record of its many investigations of potential supplies of paper-making material. In the Journal of the Institute there are many of these reports on fibrous materials; from India, South and East Africa, the Sudan, British West Indies, British Guiana, and the Malay States. If an "Imperial opportunity" is judged to have presented itself in the matter of a supply of these raw materials within the Empire, advantage may well be taken of the excellent work of the Institute.

It is characteristic of our political "method" to leave everything industrial, technical, and scientific to individual enterprise, whether of persons or corporations; and in this region of fibrous raw materials, whether for paper or textiles, we have come through under the old order with some success, and not a few conspicuous successes. In this region, moreover, we owe nothing of moment to "German method," and we are not under any moral pressure to advertise it by reiterated comparisons. But we are conscious of a new order under which we have to co-ordinate our industries. In the small section under consideration much work has been done by individuals and corporations—prophetic individuals and some profit-earning corporations—much material has accumulated, and it is open to a political pioneer, not necessarily a lawyer, to take in hand a matter which affects immediately an important section of our industrial community—labour and capital.

Should a definite organisation result it would probably be extended to embrace the whole range of vegetable textile materials which we estimate to affect directly the interests of one-third of the working community. C. F. CROSS.

PROF. J. W. JUDD, C.B., F.R.S.

MANY will regret to hear of the death of Prof. John Wesley Judd on March 3 at his home in Kew, after some months of illness. He was born at Portsmouth on February 18, 1840, but in his eighth year went to London with his father. There he attended a school in Camberwell, and at an early age showed a love for astronomy and geology. When grown up he accepted a mastership in a school at Horncastle, Lincolnshire, where his spare time was devoted to chemistry and geology. In 1863 he became a student at the Royal School of Mines, after which he took the post of analytical chemist in some important iron and steel works in Sheffield. There began, in 1864, his friendship with H. C. Sorby, who imparted to him his newly-devised methods of petrological study, but his work in that city was brought to an end by a railway accident, which for a long time compelled him to abstain from continuous labour, so he resumed his geological studies in Lincolnshire.

In 1867 Judd joined the Geological Survey, and for the next four years was engaged in mapping Rutlandshire, with parts of the adjoining counties. But in 1871 a desire for greater freedom led him to accept an offer of temporary employment in the Education Department, and during this time began his studies of the Wealden deposits. When this work had come to an end, he devoted himself to investigating the Triassic and Jurassic deposits in Scotland and of the igneous rocks so grandly displayed in its western islands. This was a difficult task, owing to the want of good maps and to travel in that part of Scotland being less easy than at the present time. The result was a group of important papers, the first of which appeared in 1873.

These attracted much attention and led to friendships with Charles Lyell, Poulett Scrope, and Charles Darwin, the second of whom commissioned him to carry on an investigation of the volcanic districts of Europe, which he had been obliged to abandon. In April, 1874, Judd visited the Lipari Islands, going on to Vesuvius, the Phlegræan fields, and the adjacent volcanic district. He also studied the Ponza Islands, on which Scrope had published an important paper in 1827, with the great crater lakes of Central Italy, the Euganean Hills, and the volcanic districts of Hungary. After his return to England he was appointed, in 1876, professor at the Royal School of Mines in succession to Sir Andrew Ramsay. He at once began to organise the teaching, but there was not room at Jermyn Street to do this effectively, so his department was soon transferred to South Kensington, and ultimately lodged in galleries which had been constructed for the 1862 Exhibition. There he established a complete system of instruction, which was then unequalled and has never been surpassed in this country, and, in addition to this, his lucidity, patience, and kindness as a teacher secured him a full and attentive classroom. In 1896 he became Dean of the Royal College of Science, and in 1905 retired under the rule of age. It is painful to add that, after accomplishing so great a work, the officials of the Government awarded him a lower pension than he had expected, on a pretext which, if in accordance with the letter of a law, was certainly inequitable.

Judd was elected a fellow of the Geological Society in 1865, was secretary from 1878 to 1886, and president from the latter year until 1888. In 1891 he received the Wollaston medal. He was elected F.R.S. in 1877, and twice served on the council. In 1885 he was president of Section C, when the British Association met at Aberdeen, and subsequently received the degree of LL.D. from that university. In 1895 he was created a C.B., and in 1913 was made an emeritus professor of the Royal College of Science. He married in 1878 Jeannie Frances Jeyes, niece of a well-known Northamptonshire geologist, who with a son and a daughter survive him.

A list of Judd's geological papers up to 1905 (after which they become rather infrequent) is added to a biography in the *Geological Magazine* for 1905. The majority fall into groups, determined by his successive fields of work, almost all appearing in the *Quarterly Journal* of the Geological Society or the *Geological Magazine*. The first group contains papers on the Neocomian, the most noteworthy clearing away many difficulties from the Speeton Clay, and showing its relation to the Neocomian beds of the Lincolnshire wolds and of North Central Europe. Another and most important group of papers deals with the Italian islands, mentioned above, the crater lakes of Central Italy, and Lake Balaton, with the old volcano of Schemnitz in Hungary, after which the older volcanic districts, especially those connected with the Alpine system, are discussed. A third not less important group refers to Scotland, in which he investigated sundry igneous rocks on the mainland and those of Tertiary age in Skye and other islands of the western coast. These papers put an end to many misunderstandings and added much to our knowledge, although his view that the gabbro is later than the granite has not been accepted by the Survey. That also, expressed in two papers, on the relation of the fluviomarine beds of Headon Hill and Colwell Bay in the Isle of Wight has not found favour, but the two on deep borings in the London district added much to our knowledge of the underground geology of south-eastern England.

For minor papers we must refer to the above-named list, but must not forget his presidential